

GENERAL PRINCIPLES AND HIERARCHY OF HAZARD CONTROL

ELIMINATE
SUBSTITUTE
ISOLATE
ENGINEERING
CONTROLS
ADMINISTRATIVE
CONTROLS
PPE

Hazard control is the process of using resources to eliminate or reduce the opportunities for fires to start and minimize their impact when they do occur. As was previously discussed, the fire triangle is a concept which states that sufficient heat, fuel and oxygen must be present for a fire to exist. In practice, hazard control usually requires a primary focus on one of these elements, usually the fuel or heat. A welding shop, for example, must have heat. The heat used to weld and cut metals cannot be eliminated. In this case, hazard control efforts will focus primarily on controlling combustibles. The opposite is true in an office. There must be combustibles or the functions of the office cannot be maintained. The emphasis in that case is on controlling ignition sources. Both ignition sources and ignitable materials are considered, but the primary emphasis is usually on only one of these.

Separation of operations and hazards is a basic concept in loss control. The principle assumes that operations that are separated are less likely to be lost in the same fire. Separation accomplishes two things. First, it reduces the potential for a fire in the more hazardous area to spread to other areas. Second, it reduces the probability that an ignition source in the low-hazard area will cause a fire in the high hazard area. The separation of portions of a process is most commonly used for high-hazard processes. For example, the hazard of a paint spray booth that is part of a manufacturing process can be reduced by separating the spray booth from other operations. This separation may involve fire walls, distance, or other methods. An extreme example of failure to separate properly would be placement of a welding shop adjacent to a flammable liquid storage room. Separation can also be used to divide large areas even if no high-hazard process exists.

The hazard control hierarchy consists of six major approaches to handling hazards.

- Eliminate
- Substitute
- Isolate
- Engineering controls
- Administrative controls
- Personal protective equipment

This approach should be applied from the top down. Ideally, all hazards should be completely eliminated. If elimination is not possible or practical, and frequently it will not be, then substitution should be considered, and so forth proceeding down the list.

Elimination is the complete removal of the hazard. The complete elimination of a hazard is often not possible, but when it can be accomplished it has a major impact on the safety of the operation. If a process normally requires a flammable solvent and a way to perform the same work with any solvent is developed, the inherent hazards of the process are greatly reduced.

Substitution is when a more hazardous component of a system is traded for a less hazardous one. The printing industry offers an excellent example of this concept in practice. Years ago, solvents including toluene, xylene, and methyl ethyl ketone were common throughout the industry. These solvents pose serious fire risks and also personnel exposure issues. The printing industry has substituted less hazardous solvents such as isopropyl alcohol in many operations. Alcohol is also flammable but is not as high a risk as the previously mentioned solvents.

Isolation involves placing the hazard in a remote or contained area away from other portions of the operation. The explosives manufacturing industry has done this practically from the beginning of their industry. Production areas are separated by distance and/or blast walls so that an explosion in one area is unlikely to affect the entire facility.

Engineering controls are systems that should not require direct human intervention to work effectively. These may be used in both prevention and control areas. A prevention example is a spring-loaded valve handle on a flammable liquid dispensing arrangement. This is designed to prevent an individual from opening the valve and leaving the area with flammable liquid still flowing.

These controls are systems that monitor conditions within a process and can shut down the process automatically if some aspect of the process gets out of

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control. This limit switch will shut down the system if temperature exceeds a predetermined upper limit. Fire protection systems are also engineered controls. These systems are designed to operate automatically and control or extinguish a fire.

Engineering controls are only as effective as people make and maintain them. An improperly designed control will not function correctly when needed. All engineering controls will require some level of maintenance and occasional repair. If a system is not maintained properly, it may not perform as designed when needed. All engineering controls will require some level of maintenance and occasional repair. If a system is not maintained properly, it may not perform as designed when needed. Engineering controls may also be intentionally defeated. The spring-loaded valve mentioned above may be propped open by an operator to allow him/her to do something else while a container fills, thus defeating the purpose of the valve.

Administrative controls include policies, procedures, rules, and training. Administrative controls are less effective than the previous elements of the hierarchy because they rely heavily on people for effective approach to hazard control. There are many occasions where engineering controls must be supported by administrative controls. For example, bonding and grounding of flammable liquid containers during transfer operations is an engineering control. Administrative controls including procedures for use and appropriate training must be in place for this system to function properly.

an acceptable range. Temperature limit switches are an example of this type of control. A furnace used for heat-treating metal parts will be equipped with a high temperature limit switch separate from the thermostat.

Personal protective equipment (PPE) is the last line of defense for hazards that pose a threat to people. For example, fire retardant clothing is a common requirement in petroleum refineries. Much effort is expended to ensure that fires do not occur, but the nature of the materials and processes makes it likely that at some point there might be a fire. Fire retardant clothing provides an extra measure of protection to the people that work in these areas.

Reference:

Schroll, R.C. Industrial Fire Protection Handbook. Florida: CRC Press. (2002)

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